X-ray Spectroscopy with Very High Spatial Resolution at NSLS-II

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The National Synchrotron Light Source II is a synchrotron radiation source of extremely low emittance, ideally suited for experiments in need of coherent radiation. It provides an ideal platform for sub-micrometer focused beam instruments. The Sub-micrometer Resolution X-ray spectroscopy beamline (SRX) has been developed specifically as an X-ray fluorescence analytical probe utilizing Kirkpatrick-Baez (KB) focusing mirrors. The scientific emphasis is the study of complex systems with chemical heterogeneity at sub-micrometer and sub-100 nm length scales. The beamline design provides X-ray spectroscopy capabilities in the energy range from 4.65keV to 23keV. The SRX beamline is one branch of a canted sector at NSLS-II, with a second undulator planned as a future upgrade to serve as an independent light source for another beamline, the X-ray fluorescence nanoprobe (XFN). The XFN design envisions a complementary beamline to SRX that will access lower X-ray energies (2-15 keV) and will utilize Fresnel zone plate optics. SRX uses two sets of KB mirror optics for focusing, a high photon flux set that will deliver more than 10^{13} phot/sec in a sub-micron sized spot and a high spatial resolution set that will deliver a focal spot size of less than 100nm but at a lower flux of approximately 10^{11} phot/sec. A highly customized horizontally deflecting double crystal monochromator was chosen to provide maximum beam stability while simultaneously providing very high spectral and spatial resolution. The energy range covered by the SRX beamline will allow for X-ray absorption spectroscopy experiments starting at the K-absorption edge of titanium and extending through the K-edge of rhodium. The photon flux SRX delivers in a submicron-spot, ultimately combined with the use of new energy dispersive detectors like the MAIA, will open new possibilities for spectroscopic analysis of major and trace elements in natural and synthetic materials, X-ray fluorescence imaging of their distribution both in two and three dimensions utilizing tomographic methods, and, concurrent micro-diffraction measurements. Diffraction imaging experiments will be developed as well. A detailed description of the SRX beamline, including results from commissioning and first experiments will be presented.